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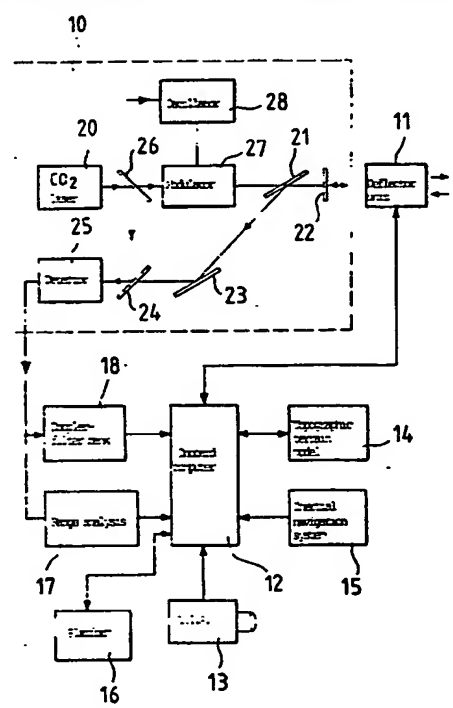
(54) A target-locating system using a topographic terrain model

(57) A military vehicle is provided with a computer 12 capable of processing a topographic terrain model 14 of its surroundings to identify sectors of threat. A thermal imaging system 13 examines these sectors and hot-spots are examined for movements by a Dappler laser system 10. If such movement is detected ranging is carried out 17. All this reduces scan time.



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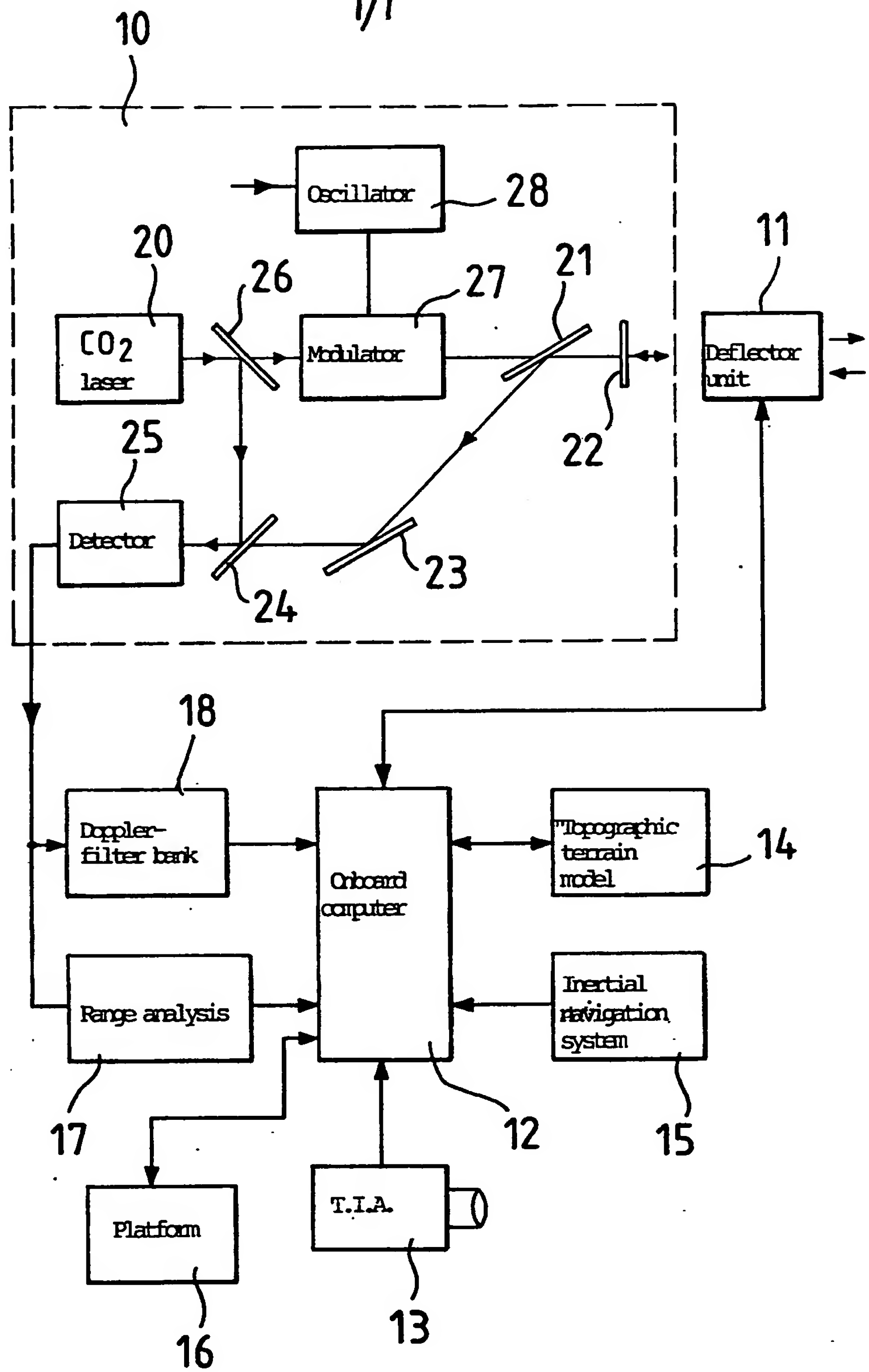
10
Oscillator
28
20
26
27
21
11
CO_2 laser
Modulator
Deflector unit
22
25
Detector
24
23
18
Doppler-filter bank
Onboard computer
Topographic terrain model
14
Range analysis
Inertial navigation system
17
12
15
Platform
T.I.A.
16
13

TARGET-LOCKING SYSTEM WITH LARGE ACQUISITION FIELD OF VIEW

The invention relates to a target-locating system.

Such locating systems, which have been specially developed for armoured vehicles with a so-called mast viewer, are part of the state of the art in various forms of embodiment. They have proved themselves in the field but, for monitoring larger sectors, require a very high expenditure in terms of apparatus and electronics and, in many cases, are operationally too slow owing to the large size of the acquisition field of view.

The task underlying the present invention is one of providing a target-locating system of the type mentioned at the outset, in which not only the expenditure for large-sector monitoring is reduced, but also in which the required acquisition time is also shortened, so that the expenditure-free concept of an all-round vision is made possible.

In solving this task the present invention provides a target locating system, preferably for armoured vehicles having a mast view finder, comprising a locating sensor arrangement, characterised in that by means of a topographic simulation model provided in the locating system of the armoured vehicle, and of data on

the armoured vehicle's own location, one or more elevationally narrow, strip-shaped acquisition fields for all-round view or for a particular sector are computed by the onboard computer, which acquisition fields correspond precisely to those locations which can be penetrated by or from which can rise low-flying aircraft or flying bodies, and that only these acquisition fields are monitored by the locating sensor arrangement.

The invention will be described further, by way of example, with reference to the accompanying drawing in which the single figure is a block circuit diagram of a preferred embodiment of the target locating system of the invention.

The preferred target locating system comprises a locating sensor arrangement consisting of a CO_2 -laser-heterodyne sensor 10 and a thermal imaging unit or apparatus 13. The sensor 10 and apparatus 13 are mounted, so as to be pivotable in all degrees of freedom, on platform 16 of a mast viewer (not shown) of a carrier vehicle (not shown) such as a tank or a rocket launcher vehicle. The CO_2 - laser-heterodyne sensor 10 operates as a Doppler-effect target velocity sensor and range detector.

The fundamental concept of the invention is that an all-round or large-sector monitoring with locating sensors of limited scanning speed can only then be carried out in a sufficiently short time if the overall target-acquisition field is subdivided in segments of one or several relatively small fields of view - which may contain targets - and in a relatively large residual field of view which may not contain any targets, prior to the commencement of the search program.

This segmentation is made possible by the fact that the position of possible targets, owing to the limited flight velocity of these targets, cannot vary with an arbitrary speed. Thus, the targets can only displace themselves by a relatively small amount between two successive scanning cycles of the overall target acquisition field of view. Therefore, the targets cannot just appear suddenly within a target acquisition viewing field or segment. It therefore suffices to detect the entry of a target in such a segment. These segments must then be so selected, that they are as small as possible with respect to space angle in order to allow a rapid scanning. On the other hand, they must also be so shaped and laid out that all targets are acquired on entering one of the segments. These segments are formed by a narrow strip on the horizon about hills, mountains, etc., and computed from the

terrain model and of the positioning of the locating system.

In order to enable the vehicle to be continuously aware of its own position in the field, an onboard computer 12 of the vehicle receives the data of an inertial navigation system 15 and the data of the previously composed, topographic terrain model 14 as well as the viewing direction of platform 16. In addition, the measurement data - e.g. terrain contours - supplied by the locating sensor arrangement are also fed to the onboard computer 12 to further refine the determination of position. The onboard computer 12 calculates now from these data one or more elevationally narrow, strip-shaped acquisition search fields for all-round view or for a particular sector. To this end, however, only the values of such terrain areas, etc. are taken into account in which low-flying aircraft or flying bodies can penetrate or rise from. With reference to the carried terrain-simulation model 14, the onboard computer 12 continuously determines the horizon line corresponding to and associated with the instantaneous location of the vehicle and furthermore all those lines which correspond to the imaginary shadow cast by ground rises, etc., below the horizon. From all the previously mentioned values and the respective distance of location of these lines - which may be

referred to as "shadow-lines" - the acquisition field of view is derived in such a manner, that this acquisition field is composed of one or several strip-shaped segments of predetermined height, for example 200 m.

Provision is made further to the effect that in this thermal-imaging acquisition field - reduced to the aforementioned segments, a single-pass image processing defines the points of interests, which correspond to possible real and spurious targets - e.g. "hot spots". These points are then ranged on with the beam of the CO_2 - laser-heterodyne sensor 10, so that a further considerable reduction of the segments to be scanned is achieved. To this end, the sensor 10 is provided with a beam-deflector unit 11 the values of which are of course also fed into the onboard computer 12. In order to enable the recognition of a low-flying target - helicopters, ground-attack aircraft, submunition dispensers etc., - detector 25 of sensor 10 has associated therewith a Doppler-filter bank 18 and a range analyser device 17, the data of which are of course also fed into the onboard computer 12. A real target is distinguished from a spurious target thereby, in that it has a certain flight velocity which leads to a Doppler shift in the CO -laser-heterodyne sensor 10. The range analysis is triggered only on detection of a Doppler shift. This reduces the time required for

detecting moving targets to a minimum.

By means of the measures here proposed there is achieved a very effective and rapid spatial monitoring amounting to all-round vision against low-flying objects, etc. Among other things, the sensor 10 required for this purpose is composed in a manner itself known of a CO_2 - laser, the beam of which is guided through a partly transparent mirror 26 to a modulator 27 and through a deflector mirror 24 to the detector 25. The modulator 27 has an oscillator 28 associated therewith. The modulated laser beam passes through a further partly transparent mirror 21 on its way to the sensor optic 22 which, as already mentioned, has a deflector unit 11 associated therewith. The received beam is guided by the mirrors 21 and 23 to the detector 25, which through the Doppler-filter bank 18 and the onboard computer 12 defines a moving target.

CLAIMS

1. A target-locating system, preferably for armoured vehicles having a mast view finder, comprising a locating sensor arrangement, characterised in that by means of a topographic simulation model provided in the locating system of the armoured vehicle, and of data on the armoured vehicle's own location, one or more elevationally narrow, strip-shaped acquisition fields for all-round view or for a particular sector are computed by the onboard computer, which acquisition fields correspond precisely to those locations which can be penetrated by or from which can rise low-flying aircraft or flying bodies, and that only these acquisition fields are monitored by the locating sensor arrangement.

2. A system as claimed in claim 1, characterised in that the results of measurements of the locating sensor arrangement in addition to the measured values of the onboard inertial navigation system and the data of the provided topographic terrain simulation model are computed by the onboard computer of the vehicle for the continuous determination of the position of the vehicle itself in the terrain.

3. A system as claimed in claim 1 or 2, characterised in that the locating sensor arrangement is constituted by thermal imaging apparatus and a CO_2 - laser-Doppler

sensor and range finder in which the range measurement is carried out only after a moving target has been detected by Doppler measurement and the Doppler measurement in turn is only undertaken when in the thermal imaging apparatus either a "hot spot" which can be interpreted as a possible target or a movement which can be interpreted as target motion has been directed.

4. A system as claimed in any one of claims 1 to 3, characterised in that the transmitter and receiver-optic of the CO_2 - laser-Doppler sensor has associated therewith an optical deflector unit controlled by the onboard computer, which unit, together with the thermal imaging apparatus are arranged on a platform.

5. A target locating system substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

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